What's Ahead–
Emerging Research Priorities

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**Southern
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Knowledge Gaps from the Southern Forest Resource Assessment

Available information used in developing the Southern Forest Resource Assessment has allowed identification of several emerging issues about the sustainability of southern forests, but additional information is needed to refine understanding and more clearly identify problems and solutions. Each chapter in the Technical Report identifies key uncertainties in specific topic areas. The following are some key issues that cut across the various topic areas:

• **Expanding populations and impacts on ecosystems**. More heavily populated rural and urban landscapes will impact wildlife, water, and other benefits derived from forested ecosystems in the South. Additional information is needed to reduce uncertainties regarding: (1) forecasts of how and where these changes might occur, (2) how human population density influences forest ecosystems and options for their management, and (3) how development can be designed to promote forest sustainability.

• **Markets, management, and values**. Because private landowners control most southern forests, forest conditions are determined by private management choices. These choices are heavily influenced by markets for forest goods and services and by other values derived from forests. A full accounting and understanding of how values are formed and how decisions are made is crucial for clarifying how forest uses and the flow of benefits will change in the future.

• **Forest Productivity**. The productivity of forest ecosystems is a key factor in determining land allocation, forest use, and ultimately forest conditions across the South. Productivity extends beyond timber production to include the provision of wildlife, clean water, and other benefits of forests, and is influenced to uncertain degrees by several forces of change.

• **Forecasting ecological changes**. This Assessment has highlighted the multiple forces of change at work in the South's forests. Yet tools are not available for: (1) forecasting the implications of these multiple, interacting changes on the area, structure, and function of southern forest ecosystems, and (2) fully understanding the impacts on values that are derived from these systems. Such tools would help identify emerging scarcities within the region.

• **Analysis at landscape and regional scales**. Science and management conducted at these broad scales are relatively new endeavors. Most forest research has been conducted at very fine scales, often without the information needed to develop implications at broader scales. When the scale at which the science is conducted does not match the questions that are being asked, answers are often incomplete.

• **Fire ecology and management**. Elimination of natural fire cycles is one of the most substantial alterations imposed by humans on the forested ecosystems of the South. Uncertainties exist regarding: (1) the role of fire in specific ecotypes, and (2) strategies for effectively and safely reintroducing fire into forest ecosystems.

• **Pine plantations and ecosystem functions**. Some portions of the South will see increased concentrations of pine plantations. Landscape-level ecological implications of increased pine plantations are uncertain. Additional information on the wildlife implications of expanding pine plantations is needed, especially in the Coastal Plain of Georgia, Alabama, Florida, and Mississippi. ▲

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Longleaf pine seedlings

Longleaf Pine Restoration

The Longleaf Pine and Vegetation Management RWU has a long history of successes in developing forest vegetation management research for sustaining southern forests, and working in collaboration with the Longleaf Alliance to restore and manage longleaf pines. Scientists will continue work to enhance research related to nursery technology and reforestation needed to support the restoration of the longleaf pine ecosystem. The SRS will support the national reforestation specialist position that is jointly funded by the three branches of the Forest Service, meeting its commitment to the Virtual Center for Reforestation. Guidelines are being developed for longleaf pine regeneration and management through prescribed fire, application of selective vegetation treatments, and use of innovative mechanical systems. ▲

Bent Creek Experimental Forest

Bent Creek Experimental Forest has been the site for multiple studies on the forest regeneration process since 1921. Research on tree and vegetation response is complemented by studies on the response of small animals and birds to changes in forest structure and composition. Ongoing and new studies by the Southern Appalachian Forests RWU at Bent Creek include:

• GIS-based methods for predicting site quality, species composition, and productivity

• Creation of the Southern Appalachian variant of the national Forest Vegetation Simulator

• Development of a new ecological framework based on overstory tree information

• Vertebrate responses to forest canopy gap disturbance

• Fleshy fruit and mast production in the Southern Appalachians

• Response of mammals, snakes, lizards, and birds to fire

A subunit of the Southern Appalachian Forests RWU has been established in Huntsville, AL to address Cumberland Plateau Forests research needs: 1) expand efforts to develop silvicultural strategies to reestablish American chestnut, 2) establish studies to examine successional change in upland forests of the Cumberland Plateau impacted by the southern pine beetle, and 3) establish studies to enhance capability to predict development of small trees in productivity models. ▲

Hypertext Encyclopedia

The methods used to create, store, and communicate knowledge have changed little since the invention of the printing press in the middle of the fifteenth century. Repositories of knowledge still largely consist of static, linear print media that assume a single, fixed skill level by the intended audience. In southern forest science an overwhelming body of information exists that is neither easily accessible nor readily useable for ecosystem management because it has not been synthesized and integrated into a coherent, meaningful knowledge structure.

Web-based, hypertext encyclopedia theory and practice have matured enough to offer an opportunity for the Southern Research Station to significantly improve its ability to narrow the huge gap between what scientists know and what natural resource managers and decisionmakers are able to easily apply on the land. An example system has been developed by SRS scientists in cooperation with the Southern Region State and Private Forestry, Athens, GA, and the Artificial Intelligence Center of the University of Georgia, also in Athens. SRS is investigating using Web-based hypertext methodology as a new and additional method to provide a practical, efficient, and affordable way to access and use a large and ever-expanding mass of scientific knowledge. ▲

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Urban Forestry Research and Technology Transfer Center

A new problem area is being added to the Recreation, Urban Forests, and Human Dimensions Research Work Unit in Athens, GA to identify the human perceptions, uses, and values of urban forests in the South. This research program would measure the contributions of these urban forests to quality of life, recreation, safety and health of urban residents; and develop indicators of sustainable urban forest management, including both the ability of urban forests to provide sustained benefits to urban residents and the ability of urban managers to sustain urban and interface forest ecosystems over time. The technology transfer program associated with this research program will be funded jointly by the Southern Region and the Southern Research Station. ▲

Wildland-Urban Interface

The Southern Forest Resource Assessment has described an increasingly complex environment for conducting forest management and suggests a need for a broader array of management strategies. New management approaches are especially needed for managing forests in "wildland-urban interface" areas. Continued development of the newly formed Southern Center for Wildland-Urban Interface and Technology Exchange in cooperation with the Southern Group of State Foresters and the University of Florida in Gainesville is planned. This new research work unit will address research, development, and application issues for interface lands throughout the South.

To date, the Center's research and technology transfer has focused on fire in the wildland-urban interface, but further funding would expand this research program to address: (1) forest management issues in areas of increased human influence (e.g., nonnative invasive species, restoring degraded ecosystems, maintaining forest health in the context of urbanization, fragmentation, and small scale private nonindustrial forest land management); (2) public policy and planning issues in the interface, particularly as policy affects land use change, forest management and public health and safety; and (3) the need to monitor and forecast demographic and land use changes in the South. Tools developed by this program would help policy makers, urban planners, and natural resource managers address the myriad issues facing them. A strong technology transfer program will ensure application of this research and development to interface situations throughout the South.

SRS and Louisiana State University will also develop a cooperative research program in social science to address legal, regulatory, and economic dimensions of natural resource management decisions in the wildland-urban interface: (1) local ordinances and regulatory impacts on forest management in the interface, and (2) address social and economic challenges related to the wildland-urban interface along the north shore of Lake Ponchartrain. ▲

Coweeta Hydrologic Laboratory

The Coweeta basin was set aside as an experimental forest in 1934. Measurements of rainfall, streamflow, climate, and forest growth continue today, providing an important long-term data source. Researchers have

Suburban sprawl covers foothills

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published extensively from the first decades of data on the effects of management alternatives at the Wine Spring Creek watershed. Coweeta is one of 24 sites of the National Science Foundation's Long-Term Ecological Research program and is a National Atmospheric Deposition Program site. Nine stations collect rainfall data used to understand the effects of the atmospheric environment on southern forested watersheds. Continuing and upcoming research will include:

• Effects of ecosystem management practices on water, soil, and forest resources through a new level of experiments in areas ranging from sediment movement to nutrient cycling

• Development and validation of nutrient cycling models

• Evaluation of cottonwood trees to remediate polluted groundwater

• Effectiveness of riparian restoration on forest environments

• Long-term forest disturbance dynamics using dendrochronological techniques

• Species-specific models to assess the effects of climate change on hardwood productivity ▲

Forest Operations Research

Research at Auburn, AL supports sound scientific forest management and policy development by describing how forest operations affect ecological factors and evaluating how technology can improve mechanical, economic, or ecological performance of forest operations. This research provides a key link between increasingly complex forest management plans and desired future conditions for clean air and water, forest products, wildlife, recreation, and other benefits. Continuing research is planned on several critical areas of forest operations, including knowledge of how erosion varies among management activities and site factors, evaluation of technologies for environmental soundness and cost effectiveness, new machine designs for safe working conditions, evaluation of improvements in spatial and operational information, and development of precision forestry applications. ▲

Life Cycle of Wood

The Tree Quality, Processing, and Recycling RWU conducts research to enhance wood resource conservation and sustainability through advanced timber analysis and wood processing, and effective wood product recovery, reuse, and recycling. The largest use of hardwood lumber is for pallets, many of which end up in landfills. Work by scientists in Blackburg, VA on pallet repair and recycling has kept millions of pallets out of landfills. The RWU does extensive outreach and technology transfer to bring pallet users together with recyclers and distributes business plan software to potential recylers. Future work includes continuing collaborative efforts with Virginia Tech and the National Wooden Pallet and Container Association on research to design pallets for particular purposes with used parts. Study continues on ways to recover and reuse CCA-treated wood products and on possible solid-wood uses for recovered CCA treated lumber. The use of CCA as a preservative is being phased out. ▲

Forest Inventory and Analysis

Sending field measurement personnel to all field plots over specified, and often large, areas can be prohibitively expensive for forest management planning and applications. Development of the use of time-sequenced remotely sensed data, in the form of aerial photography or satellite spectral sensors is continuing, in order to stratify forest components by populations of interest and to detect changes. Other monitoring techniques are continuing that will improve the assessment of forest health relating to a variety of resource conditions and issues. This work is necessary to improve statistical modeling and estimation of critical resource attributes. The work will result in models that allow projection of stand growth and development for feasible future use and change scenarios.

Statistical modeling offers the potential to make risk projections for fire/vegetation and fire/insect interactions and to inventory and monitor invasive insects. To accomplish this development, data are needed to allow modeling for fire risks due to vegetation laddering in pine plantations. ▲
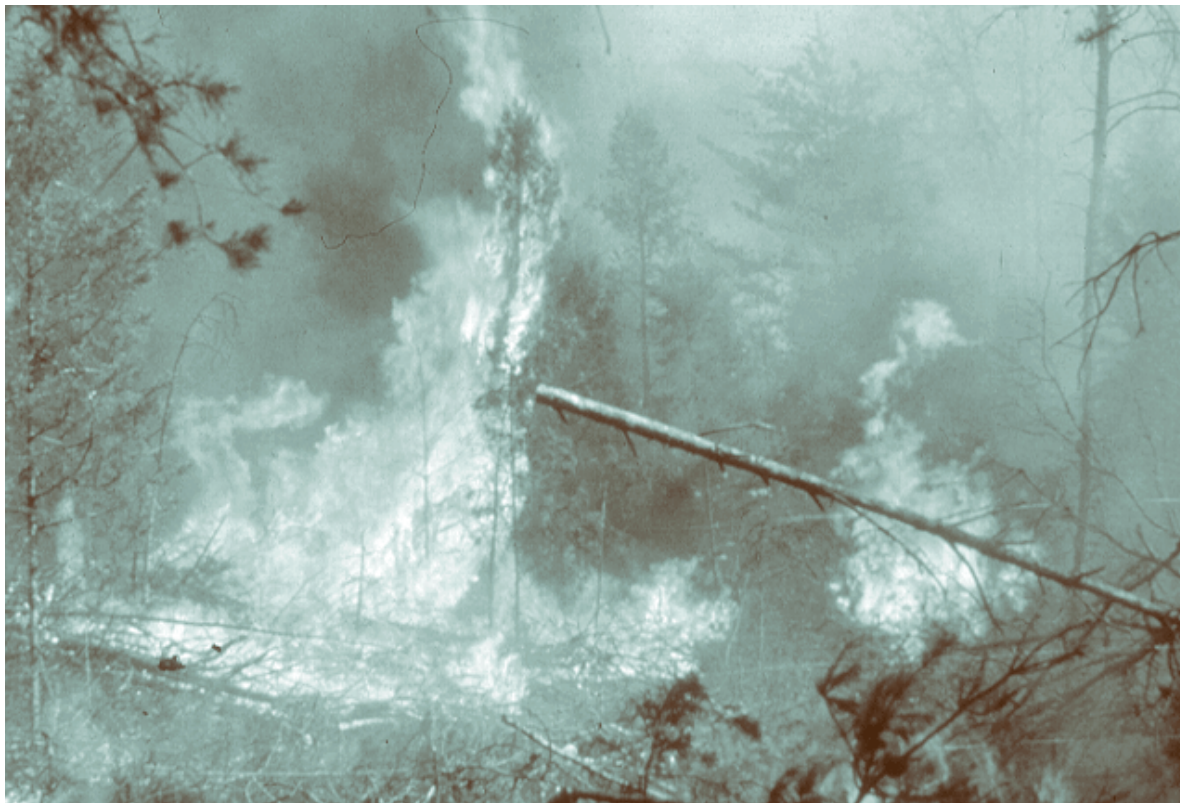
Fire

Economic and wildfire production analyses performed for Florida need to be expanded to other fire-prone states in the South, including Texas and Gulf Coast States. This research will link broad-scale wildfire damages to vegetation management and ecological, demographic, and climatic conditions. Costs and benefits associated with prescribed fire will be analyzed in terms of timber management growth and yield, operational cost reductions and non-timber market and non-market values in this fire-prone region. SRS will develop models to predict weather and fire occurrence at finer levels of resolution, to predict smoke movement, and model relationships of climate to fire season severity.

Synergistic detrimental effects of fire and bark beetles are of concern to forest managers. Fires, especially growing season burns, are increasingly associated with subsequent mortality due to bark beetles. Conversely, mortality due to bark beetles leads to increased fuel loading. To better utilize fire as a management tool, and minimize unwanted effects, an increased research effort would help understanding the conditions under which fire predisposes trees to bark beetles and non-native invasive insects. Modeling research will assess the significance of bark beetle mortality on fuel loadings in the region.

It appears that oak dominance may be significantly curtailed following disturbance, including fire. The potential role of fires both historically and as a silvicultural tool in oak regeneration requires additional research. Hypotheses of fire effects will be tested and the findings will serve as a basis for development of prescribed fire regimes should results suggest positive effects of fire on oakregeneration. This work will supplement existing strategies for restoration and maintenance of upland oak ecosystems. ▲

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Forest fire